MORS
Military Operations Research Society

75th MORSS CD Cover Page

712CD

For office use only 41205

UNCLASSIFIED DISCLOSURE FORM CD Presentation

12-14 June 2007, at US Naval Academy, Annapolis, MD

Please complete this form 712CD as your cover page to your electronic briefing submission to the MORSS CD. Do not fax to the MORS office.

Author Request (To be completed by applicant) - The following author(s) request authority to disclose the following presentation in the MORSS Final Report, for inclusion on the MORSS CD and/or posting on the MORS web site.

Name of Principal Author and all other author(s):
Raymond B. Devore
LTC Lawrence V. Fulton
Principal Author's Organization and address:
1608 Stanley Road
Fort Sam Houston, TX 78234-5047

Phone: 210-221-0048

Fax: 210-295-0229

Email: ray.devore@amedd.army.mil

Original title on 712 A/B: From Deterministic to Stochastic

Revised title: Same as above

Presented in (input and Bold one): (**WG 23**, CG___, Special Session ___, Poster, Demo, or Tutorial):

This presentation is believed to be:
UNCLASSIFIED AND APPROVED FOR PUBLIC RELEASE

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **01 JUN 2007**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**

4. TITLE AND SUBTITLE **From Deterministic to Stochastic**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Center for AMEDD Strategic Studies 1608 Stanley Road Fort Sam Houston, TX 78234-5047**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM202526. Military Operations Research Society Symposium (75th) Held in Annapolis, Maryland on June 12-14, 2007, The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**15**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

From Deterministic to Stochastic

75th MORSS
Raymond B. Devore, Jr.
Pat M. McMurry
LTC Lawrence V. Fulton

CASS
Center for AMEDD Strategic Studies
Fort Sam Houston, Texas

Agenda

- Background
- Data
- Problem Statement
- Deterministic Model
- Partial Stochastic Model
- Full Stochastic Model
- Future
- Conclusion

Background

- Preventive Medicine Detachment Rule of Allocation was 1 Detachment per 17,000 personnel
- We had 54 tasks with time and frequency
- Short turn around
- Our task was to determine if that rule was appropriate

- H_0: Mean = 17,000
- H_A: Mean != 17,000

Data

- 54 PM tasks with time and frequency
- Original data from contractor questionnaire unusable
- Provided by the PM SME using PMJ consensus panel
- Three formats for time and frequency
  - Single value
  - Minimum and maximum values
  - Minimum and maximum values, with a most likely value

Problem Statement

- Eliminate Point Estimates
  - Single number answer
  - No certainty in comparing to test value
- Provide Range Estimates
  - Minimum-Maximum values
  - Allows for risk decisions
- Limited data
- How can we use this limited data to provide an accurate range estimate to determine if 17,000 is within the range with an appropriate level of confidence?

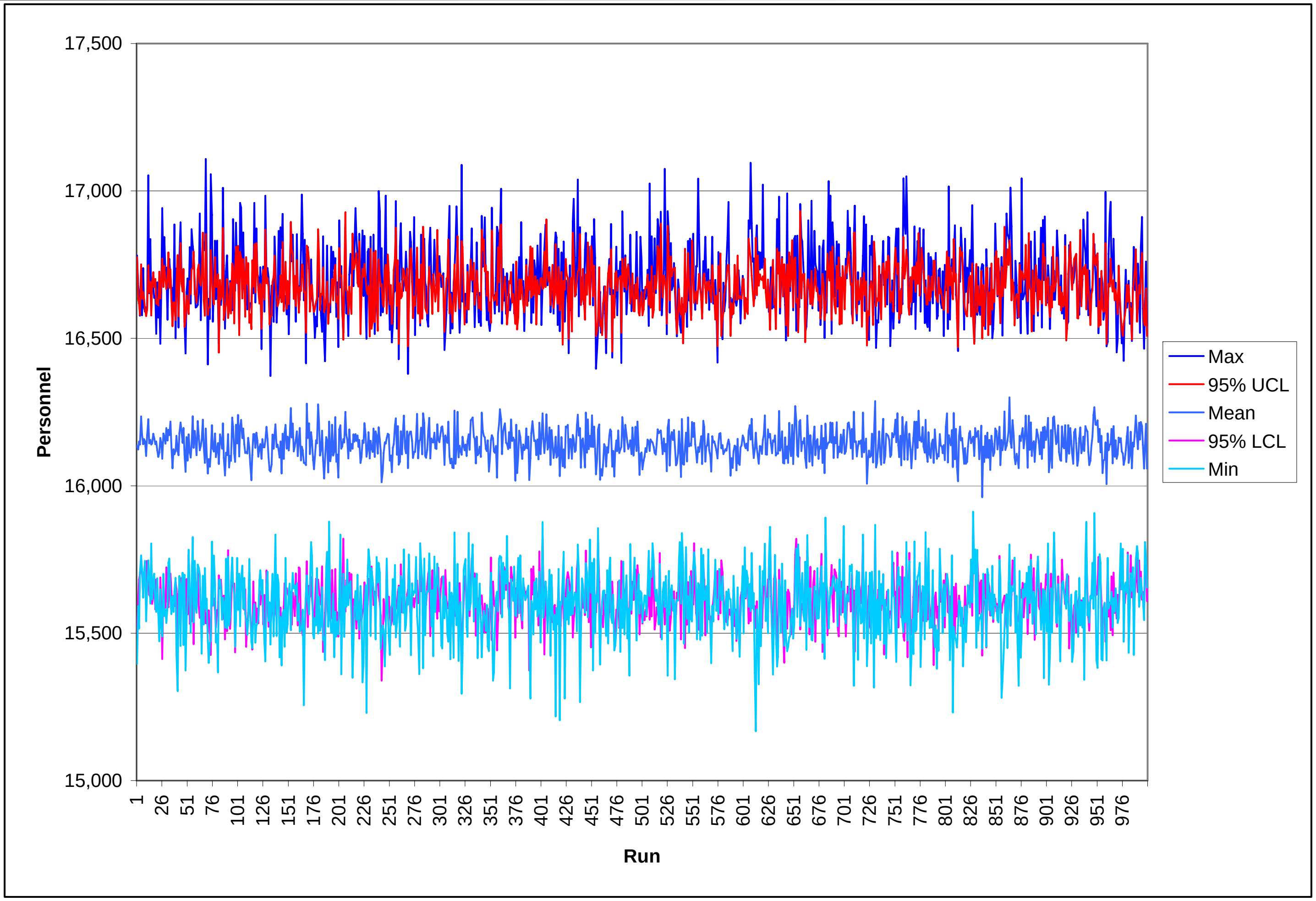
Deterministic Model

- Provides same point estimate, always
- Task times/frequencies used:
  - Actual value when single value
  - Average value when a range
    - (Min + Max) / 2
    - (Min + Most Likely + Max) / 3
- Limitation
  - No variation
- Result: 1 PM Detachment per 16,138 personnel
- No appropriate method to compare this to 17,000

Partial Stochastic Model

- Provides range estimate
- Based on
  - Actual value when single value
  - Uniform distribution between min and max
  - Triangular distribution with min, max, most likely
- Limitation
  - Only some tasks contributed to variation
- Result: 30,000 iterations, 95% confidence interval of (15606, 16678), with a mean of 16,142
- The 17,000 is outside this confidence interval, but is this a good representation.

Partial Stochastic Model – Results



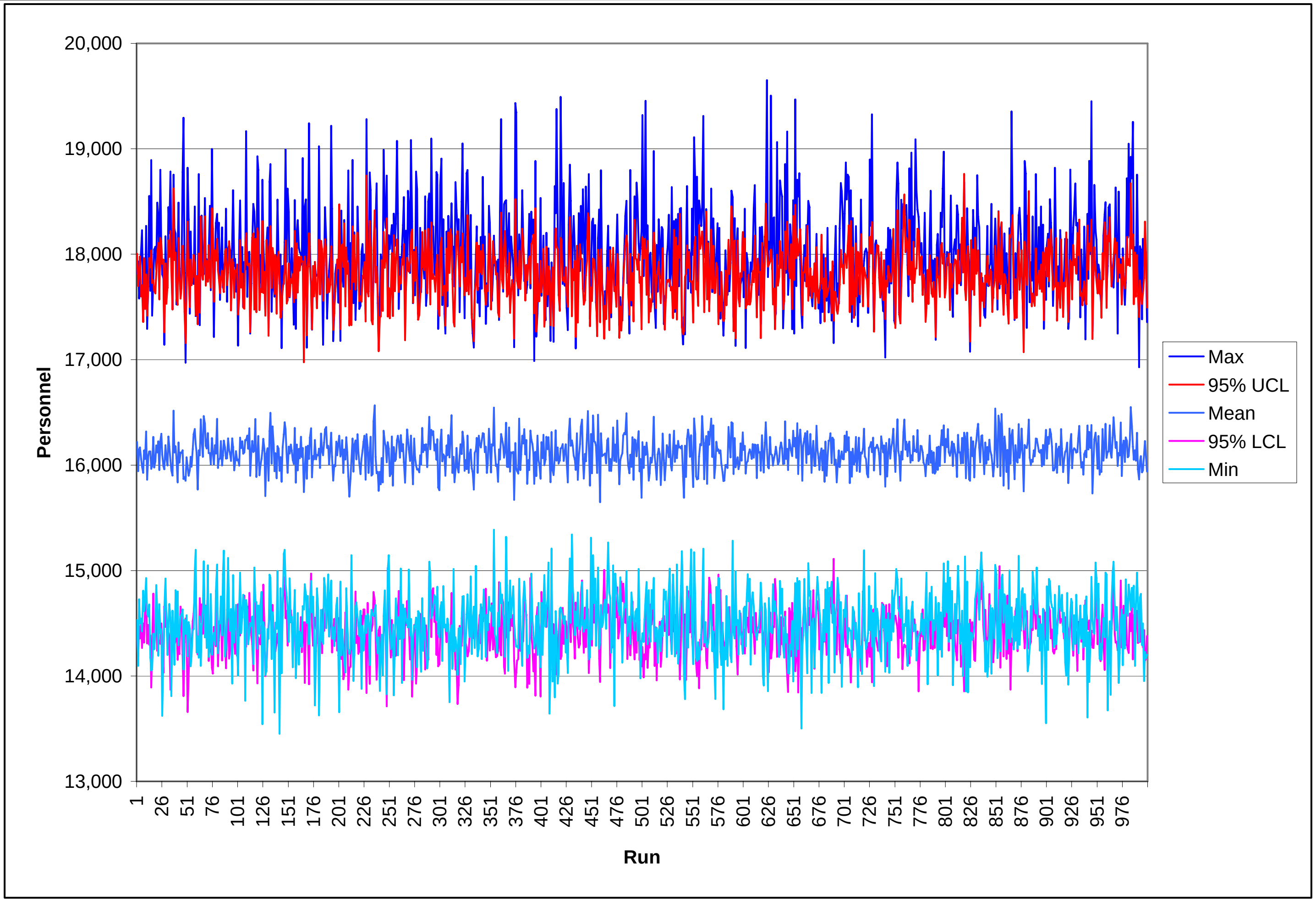
Full Stochastic Model – Setup

- Assumptions
  - Frequency were accurate
  - Distribution of time for all tasks was normal
  - Variation of time for all tasks was constant
- Calculations
  - Task: $\hat{\sigma}_i \approx (Max_i - Min_i)/6$
    - Covers 99% of normal distribution
  - Task: $\hat{\mu}_i \approx (Min_i + Max_i)/2$
  - Task: $CV_i = \hat{\sigma}_i / \hat{\mu}_i$
  - Composite: $E(CV) = \sum CV_i / n$
  - Task: $\hat{\sigma}_i \approx Val_i * E(CV)$
  - Task: Single values converted to ranges
    - Min = Val – 3 (Val * E(CV))
    - Max = Val + 3 (Val * E(CV))

Full Stochastic Model - Implementation

- Provides range estimate
- Based on:
  - Uniform distribution between min and max (original or calculated)
  - Triangular distribution with min, max, most likely
- Limitation
  - Some time ranges based on assumptions
- Benefit
  - All time values in the model are stochastic
- Result: 30,000 iterations, 95% confidence interval of (14410, 17824), with a mean of 16,117
- The 17,000 is within this confidence interval.

Full Stochastic Model – Results



Future

- Developing survey for PM SMEs
- Will give data to develop distributions for all task times and task frequencies
- These distributions will improve the current model

Conclusion

- As the number of stochastic variables increased, the results allowed the decision maker to better estimate the risk of the decision made.
- Selecting a value near the upper limit, accepts more risk but a lower cost (less detachments).
- Selecting a value near the lower limit, provides less risk but a higher cost (more detachments).
- Need to improve data through survey

- All models are wrong, some are useful.
  -- George E. P. Box, Ph.D., *Empirical Model-Building and Response Surfaces*

GO

SPURS

GO